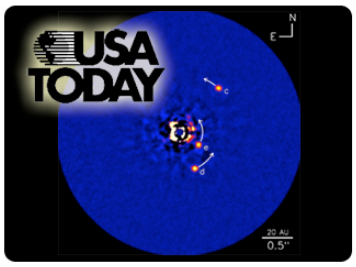
LAWRENCE LIVERMORE
REPORT

A weekly review of scientific and technological achievements from Lawrence Livermore National Laboratory, Dec. 6-10, 2010

A giant surprise



Infrared image of the HR8799 planetary system.

Laboratory scientists have discovered an inner giant planet in and unusually massive solar system much like our own.

The solar system around the star HR 8799 should not exist. This system is unlike any other known: It is a massive system that has multiple massive planets, with each giant planet containing many times the mass of all the planets in our solar system combined. But new images of HR 8799 show yet another equally massive planet is visible.

Previous work had imaged three planets around HR 8799, and now there is the surprise discovery of a fourth, HR 8799e, an inner, massive planet (about 10 Jupiter masses) located some 14.5 astronomical units from the star (1 AU is the average distance from Earth to the Sun).

If this newly discovered planet was located in orbit around our sun, it would lie between Saturn and Uranus. At about 30 million years old, this giant version of our solar system is young compared to our system, which is about 4.6 billion years old.

To read more, go to the Web.

Arsenic proves to be building block of life

LLNL's Jennifer Pett-Ridge, right, runs the NanoSIMS and analyzes some arsenic-grown cells from Mono Lake as NASA/USGS' Felisa Wolfe-Simon observes.

A bacterium found in the waters of Mono Lake is thriving and reproducing by using arsenic, known to trigger death for most earthly life forms.

Livermore and NASA researchers conducted tests in the harsh environment of Mono Lake and discovered the first known microorganism on Earth able to thrive and reproduce using the toxic chemical arsenic. The microorganism substitutes arsenic for phosphorus in its cell components.

The findings could redefine origins of life research and alter the way we describe life as we know it.

Oxygen, carbon, hydrogen, nitrogen, sulfur and phosphorous are the six basic building blocks of life on Earth. These elements make up nucleic acids, proteins and lipids -- the bulk of living matter.

For more go to the Web.

The new math

Paul Rosenkoetter displays a check given to Dougherty Valley High School in San Ramon.

The decades-old approach of teaching math in U.S. high schools doesn't add up. When it comes to the technology in use today such as Google earth, 3D animation, GPS and robotics, how can educators bring students up to date to develop the skill-set needed for mathematical problem solving in the 21st century?

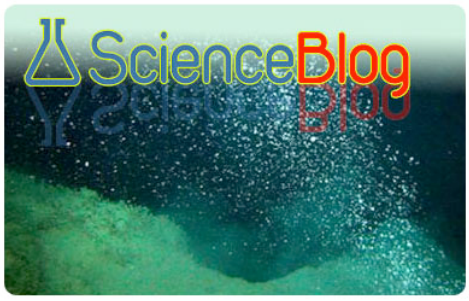
Partnering with a local courseware developer and a public high school, Lawrence Livermore National Security, LLC (LLNS), the contract manager for the Laboratory, is helping prepare local students by contributing $10,000 toward a one-of-a-kind pilot course in algorithmic geometry offered at Dougherty Valley High School in San Ramon. The course is geared toward juniors and seniors with strong math skills and an interest in high-tech careers.

Like traditional methods of teaching math, algorithmic geometry immerses students in "real world" challenges requiring creative application of math skills to find a solution - - for example, designing a computer algorithm to control a robotic arm.

Developed by biotech computer scientist Pierre Bierre and his team at Spatial Thoughtware in Pleasanton, the course seeks to disseminate the way geometric problem-solving is practiced in high-tech, and update standardized math content offered in U.S. schools for the computing revolution.

To read more, go to the Web.

Thriving on the ocean floor



Laboratory and UC Santa Cruz researchers have found that there is an extensive biological community living in porous rock beneath the deep ocean floor.

The microbes appear to be an important source of dissolved organic matter in deep ocean water, a finding that could dramatically change ideas about the ocean carbon cycle.

LLNL's Tom Guilderson and UC Santa Cruz' Matthew McCarth found evidence of the hidden microbial ecosystem beneath the seafloor by analyzing carbon isotopes in the organic molecules in their samples. Of the three naturally occurring isotopes of carbon, carbon-12 is the most abundant, and both carbon-12 and the slightly heavier carbon-13 are stable. Carbon-14 is an unstable isotope formed in the upper atmosphere through the action of cosmic rays, and its steady decay is the basis for carbon-dating of organic material.

Guilderson used the Lab's Center for Accelerator Mass Spectrometry to analyze the samples.

To read more, go to the Web.

Looking into NIF

Inside the NIF target chamber.

The National Ignition Facility (NIF) is the world's largest and most powerful laser system for inertial-confinement fusion (ICF) and experiments studying high-energy-density science.

Neutron imaging of ICF targets provides a powerful tool for understanding the implosion conditions of deuterium- and tritium-filled targets, primarily to determine the symmetry of the fuel in imploded targets. Image data is then combined with other nuclear information to gain insight into the laser and radiation conditions required to drive the targets to ignition.

To perform neutron imaging, a pinhole assembly is placed 26 centermeters from the target-chamber center (TCC). It consists of an array of 37 pinholes that produce multiple images at a scintillator on an optics table located 28 meters from the TCC.

NIF is expected to begin fusion ignition experiments next year. To read more, go the Web.

LLNL applies and advances science and technology to help ensure national security and global stability. Through multi-disciplinary research and development, with particular expertise in high-energy-density physics, laser science, high-performance computing and science/engineering at the nanometer/subpicosecond scale, LLNL innovations improve security, meet energy and environmental needs and strengthen U.S. economic competitiveness. The Laboratory also partners with other research institutions, universities and industry to bring the full weight of the nation's science and technology community to bear on solving problems of national importance.

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